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PTO/SB/05 (4/98)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	530.37031CP2
First Inventor or Application Identifier	Neil G. SCOTT
Title	See 1 in Addendum
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)*
(Submit an original and a duplicate for fee processing)

2. [X] Specification [Total Pages 30]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 7]

4. Oath or Declaration [Total Pages 1]
a. [ ] Newly executed (original or copy)
b. [X] Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
i. [ ] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13 IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*

6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. [ ] Computer Readable Copy
b. [ ] Paper Copy (identical to computer copy)
c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [X] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. [X] * Small Entity Statement(s) *(PTO/SB/09-12)* [X] Statement filed in prior application Status still proper and desired
14. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. [X] Other: See 2 in Addendum

16. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
[X] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: 09/107,807
Prior application information: Examiner S. Broda *Group / Art Unit:* 2763
For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[X] *Customer Number or Bar Code Label* 020457 *(Insert Customer No. or Attach bar code label here)* or [ ] *Correspondence address below*

Name					
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Country		Telephone		Fax	

Name (Print/Type)	Carl L. Brundidge	Registration No. (Attorney/Agent)	29,621
Signature		Date	May 30, 2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231.

Attachment to PTO/SB/05 (4/98) Utility Patent Application Transmittal

1. DEVICES AND METHODS FOR INTERFACING HUMAN USERS WITH ELECTRONIC DEVICES
2. - Power of Attorney by Assignee of Entire Interest
   - (Revocation of Prior Powers)

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) and 1.27(d)) – NONPROFIT ORGANIZATION

Application No.: 09/107,807
Filing Date: 30 June 1998
Applicant(s): Neil G. Scott
Title: Devices and Methods for Interfacing Human Users with Electronic Devices

I hereby declare that I am an official empowered to act on behalf of the entity identified below:

Name of Concern: **The Board of Trustees of the Leland Stanford Junior University**
Address of Concern: **900 Welch Road, Suite 350**
Palo Alto, CA 94304

I hereby declare that the entity identified above qualifies as a nonprofit organization as defined in 37 CFR 1.9(e), for purposes of paying reduced fees to the United States Patent and Trademark Office under section 41(a) and (b) of Title 35, United States Code, in that the entity is an institution of higher education.

I hereby declare that rights under contract or law have been conveyed to and remain with the entity identified above with regard to the invention identified above and described in the application for Letters Patent filed herewith.

If the rights held by the entity identified above are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

* NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

Name:		[ ] Individual
Address:		[ ] Small Business Concern
		[ ] Nonprofit Organization

Name:		[ ] Individual
Address:		[ ] Small Business Concern
		[ ] Nonprofit Organization

I acknowledge the duty to file, in this application for patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

ASSIGNEE: THE BOARD OF TRUSTEES OF THE LELAND STANFORD JUNIOR UNIVERSITY

Stanford University
Office of Technology Licensing
900 Welch Road, Suite 350
Palo Alto, CA 94304

Official Authorized to Act on Behalf of Assignee:

Signature: _____ 7/29/98 Date

Name: Jon Saudeling

Title: Acting Director

530.37031CP2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Neil G. SCOTT
Serial No.:	Not yet assigned
Filed:	May 30, 2000
For:	DEVICE AND METHODS FOR INTERFACING HUMAN USERS WITH ELECTRONIC DEVICES
Group:	2763
Examiner:	S. Broda

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

May 30, 2000

Sir:

The following amendments and remarks are respectfully submitted prior to the Rule 53(b) Continuation Application filed on even date.

IN THE SPECIFICATION

Please insert before the first line of the specification the following:

-- This is a continuation of application Serial No. 09/107,807, filed June 30, 1998. --

IN THE CLAIMS

Please cancel claims 2-16 without prejudice or disclaimer of the subject matter thereof.

REMARKS

Entry of the above amendments prior to examination is respectfully requested.

Please charge any shortage in fees due in connection with the filing of this paper, or credit any overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (530.37031CP2).

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

Carl I. Brundidge
Registration No. 29,621

CIB/jdc
(703) 312-6600

Patent Application

of

NEIL G. SCOTT

for

DEVICES AND METHODS FOR INTERFACING HUMAN USERS WITH ELECTRONIC DEVICES

This application is a continuation-in-part of copending U.S. Patent Application 08/409,409 filed 3/24/95, which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to methods and devices for interfacing human users with electronic devices. More specifically, it relates to techniques for communication between common electronic devices and human user input and output devices, including specialized or customized devices commonly used by users who have disabilities.

BACKGROUND OF THE INVENTION

As electronic devices are becoming increasingly prevalent in the world, the use of such devices is becoming increasingly necessary for the normal performance of our major life activities of working, learning, and generally enhancing the quality of life. Yet, although these electronic devices are easily accessible to most people, they are partially or entirely inaccessible to certain individuals with disabilities, whose normal performance of major life activities is thereby substantially limited.

The root of this disparity in access to electronic devices lies in the fact that people use various individualized and specialized modes of communication, while electronic devices are normally designed to interface with humans via one or two fixed modes. It has become customary to design all electronic

devices to use standard input and output devices to communicate with people because most people have normal visual, motor, and auditory abilities that enable them to use these standard devices. The electronic devices, however, then become inaccessible to many people who temporarily or permanently lack these normal abilities. For example, the typical human communicates with a computer via a display screen, a keyboard and a mouse. Consequently, most computers are partly or completely inaccessible to any human with a visual or motor disability. The same limitations apply to most other electronic devices which are designed with particular input and output devices built into the same physical encasing. Such is the case, for example, with microwave ovens, automatic teller machines, telephones, fax machines, and vending machines. The input devices (usually including an arrangement of keys) and output devices (usually including a simple visual display and/or auditory tones) in these cases are normally fixed for the life of the device. This immediately limits their accessibility to those people having the corresponding motor and visual skills.

Numerous other problems arise because of these design limitations. For example, most people, when they find it necessary or desirable to switch from one computer to another, usually can adapt easily to a new input device, such as a different keyboard. For an individual with a disability, however, such a change can involve great inconvenience and may even be practically impossible. Consider, for example, a girl who is unable to operate a conventional keyboard. She may have an obvious disability due to paralysis or amputation, or some less obvious condition such as multiple sclerosis, ALS, carpal tunnel, or tendonitis. One way for her to communicate with her personal computer is through a custom-designed headband which permits her to send signals similar to Morse code to her computer using muscle contractions in her forehead. The computer and

its software are custom modified to convert these coded signals into certain keystrokes. This personal input device, however, must be designed to operate in accordance with the particular hardware specifications of her computer. As a result, switching to a different computer would involve disconnecting the personal input device from her computer and connecting it to the other computer. If the other computer is not the same model, this may involve redesigning the personal input device hardware to conform to the different hardware specifications of the other computer. In addition, the operation of her headband requires customized computer software that decodes the Morse code signals, and this software must also be adapted to the other computer. Clearly, the prospect of switching computers would be inconvenient for her, if not practically impossible, and the girl would be limited to using just one computer which is specially equipped for her.

Similar difficulties arise with individuals having other types of disabilities and, consequently, with other types of personal input and output devices. For example, instead of the headband, the girl of the above example could use an eye tracker or speech recognition system for input. Such a system also involves custom designed hardware and software for use with a particular computer system. Again, switching computers would be inconvenient or impractical.

Although the special headband enables the girl in the above example to gain access to her home computer, all the other electronic devices in her home such as telephones, fax machines, and microwave ovens present accessibility problems to her as well. To gain access to all these devices, it would be necessary to custom-design special hardware and software interfaces for each device; needless to say, this would be an expensive endeavor. Even if an elaborate effort were made to customize these devices for her use, whenever

she purchased a new phone, TV, stereo, or microwave oven, she would have the additional expense of customizing it. More limiting, however, is the fact that this solution does not give her access to any electronic devices outside of her own home. In short, the traditional solution of customizing private devices to understand individual input and output devices does not solve the central problem of accessibility since it is expensive, inconvenient and does not allow access to public devices.

In addition to limiting the personal freedom of many individuals with disabilities, the restricted accessibility of many electronic devices can have detrimental effects on anyone who uses them. For example, individuals whose work involves long hours of computer data entry via keyboard often develop carpal-tunnel syndrome which thereafter limits their ability to type. A person previously able to access a computer through a keyboard then becomes a person disabled from doing so. In other words, computers that are limited to keyboard input become inaccessible to the very people who need to use them the most. Similar problems arise in relation to pointing devices and video displays. Thus, limitations to the input and output devices associated with electronic devices inevitably and inadvertently limit the accessibility of those very devices, and consequently limit the freedom of the individuals who use them.

One obvious way to make electronic devices accessible via many different modes of communication is to build the devices with all possible input and output interfaces. This solution, however, is economically unfeasible. Moreover, it is practically impossible to provide every electronic device with an entire array of various specialized input and output devices to accommodate every possible human access preference or need. On the other hand, it is equally impractical to customize every device an individual may need to use as the

need arises. Accordingly, there is a widespread and long-standing need for devices and methods to address these important issues of human accessibility to electronic devices.

SUMMARY OF THE INVENTION

Clearly, the bondage of electronic devices to fixed input and output devices will only increase the problems of accessibility as these electronic devices become even more important and pervasive in our culture. It is therefore a primary object of this invention to provide a method communication between customized human user interface devices and electronic devices that does not require customization each time a person uses a different device, and does not require devices to be equipped with all possible user interface devices. The present invention overcomes the problems associated with providing equal access to electronic devices by liberating electronic devices entirely from dependency upon specific input and output requirements and thereby permitting any electronic device to be accessible to anyone. The invention achieves these and other objects by providing a method for communication between human interface devices and target electronic devices that is independent of the specific input and output codes and formats of the devices, thereby clearly separating user access requirements from the electronic device hardware and software.

The advantages of this method of communication are profound and far-reaching. Individuals with disabilities will be able to switch from computer to computer just as easily as individuals with normal abilities. In particular, there is no need for redesigning or customizing the hardware or software of the electronic device in order to make it accessible to the specific user interface needs of an individual. Using the method of the present invention,

disabled individuals will have total access to electronic devices such as ATMs, telephones, fax machines, elevators, copiers, and vending machines. This method therefore provides the means for making these important electronic devices equally accessible to everyone. It also provides an efficient and economical way for employers to comply with the Americans with Disabilities Act which requires them to provide reasonable accommodations to individuals with disabilities. Disabled employees can receive customized user interface equipment and training independent of the employment situation. For their work, however, they can use the same hardware, software, and training as any other employee.

This method of communication will also provide new flexibility and freedom to individuals without disabilities because the mode of communication used to access a device can be changed easily without inconvenient and expensive changes to the electronic devices themselves. For example, a keyboard input device can be interchanged with a speech recognition input device without any change whatsoever to the computer with which they are used to communicate. This flexibility allows a user to quickly and easily change his or her method of communication with the same electronic device. By eliminating the prolonged repetition of restricted manual movements, the invention helps to prevent carpal-tunnel syndrome and other physical ailments.

This method of communication also has the great advantage that special input and output devices can be customized to suit the needs and preferences of a particular individual without at the same time limiting the accessibility of the electronic devices with which the individual may wish to communicate. For example, a personalized speech recognition device can function with higher efficiency and convenience than a much more complicated device designed to accommodate

any possible person, regardless of vocabulary, dialect, or language. Yet such an input device, when combined with this method of communication between electronic devices, will not thereby restrict the accessibility of the device to others since the method for accessing the devices has been separated from the devices themselves. The advantages of personal customization, therefore, can be combined with the advantages of unlimited access to electronic devices.

The above objects and advantages are accomplished by an approach that decouples electronic devices from specific input and output devices and inserts a universal communication link between them. In one aspect of the invention, a system is provided that includes a collection of N human user interface devices ("accessor devices") $A_1,\ldots,A_N$, which may be customized for interfacing with a particular human who has specialized access needs or preferences. In the prior art such accessor devices are connected directly to one or more electronic devices ("target devices") $B_1,\ldots,B_M$ that are customized for communication with the accessor devices. According to the teaching of the present invention, on the other hand, the accessor devices are instead connected to a first total access port A. Moreover, the collection of M electronic devices $B_1,\ldots,B_M$ are connected to a second total access port B. Total access ports A and B convert data between a device-dependent form and a device-independent form. A total access link between total access port A and total access port B is an information link over which data in the device-independent form is transmitted between the total access ports. The total access link may be implemented as an infrared link, an electronic cable link, a fiber optic link, a radio link, a computer network or any other well known information link. Because the data transmitted over the total access link has a device-independent form, i.e. it does not contain codes or formats that are limited to the hardware

codes or formats used by devices $A_1,\ldots,A_N$, or by devices $B_1,\ldots,B_M$, the target devices are not limited to any particular accessor device, and the accessor devices are not limited to any particular target devices. Instead of representing information in terms of device-dependent hardware codes, the data transmitted between the total access ports represents information in a user-functional form, i.e. it directly represents the interaction of the human user with the input or output device. This user-functional representation is device-independent in the sense that it is not dependent on any particular hardware device codes. Insofar as the user interacts in a different manner with different devices, the user-functional representation may change. Such changes, however, are not device-dependent in the sense of depending on fixed codes internal to the device.

In another aspect of the invention, a method of communication between human user interface devices ("accessor devices") and electronic devices ("target devices") involves receiving at the N accessor devices $A_1,\ldots,A_N$ input from a human user, sending from the N accessor devices $A_1,\ldots,A_N$ to total access port A device-dependent data derived from the input, translating at the total access port A the device-dependent data into device-independent data, transmitting the independent data over the total access link from total access port A to total access port B, translating the device-independent data into device-dependent data appropriate to the M target devices $B_1,\ldots B_M$, and sending the device-dependent data to the M target devices $B_1,\ldots B_M$. The data can also flow in the reverse direction in an analogous manner.

The method can provide a universal communication link between any kind of accessor device and any kind of target device. The accessor devices $A_1,\ldots,A_N$ could be any type of human interface device, for either input from a user or output to a

user, such as a keyboard, a mouse, a video monitor, a liquid-crystal display, an LED display, a speaker, a voice synthesizer, a speech recognition system, a remote control, a headband switch, an eye tracker, a printer, a personal data assistant, a sound generator, a Braille display, a tactile display, or a virtual reality display. The target devices $B_1,...B_M$ could be any type of electronic or electrically controlled device that a human user might want to control, use, or otherwise interact or communicate with, such as a computer, a stereo, a TV, a VCR, an environment controller, an ATM, a vending machine, a telephone, a fax machine, an elevator control system, a pager, a copier, a microwave oven, an industrial controller, a telcom device, an appliance, a car, an airplane, or an information kiosk.

In one embodiment of the invention, a total access link is used to connect a desktop or laptop computer to a specialized input device including a speech recognition system and a sound and voice interface for facilitating speech input. In this embodiment the information link is a bi-directional infrared serial data link and the data is transmitted in packets using full error-handling, error-correction, handshaking, data compression, and data decompression. A universal data packet can be one of many different generic types: a keyboard packet, a mouse packet, a video packet, a target data packet, a control packet, and an accessor-to-accessor packet. Every packet, however, has a universal form: a header which defines the type of packet, a byte-count of the number of data bytes in the packet, a collection of data bytes, and a 2-byte cyclic redundancy check (CRC). Although there are different generic types of packets, the data contained in the packets has a user-functional representation rather than using arbitrary device codes to represent information, i.e. the data directly represents actions performed by the human user.

In another embodiment of the invention, a total access link is used to connect an ATM to a specialized input device including a speech synthesizer and speech recognition system. In this embodiment the information link includes a bi-directional infrared serial data link with both long-range and short-range modes, and a one-way radio frequency link. This embodiment helps a person to locate an ATM machine by sending a radio frequency wake-up call from the person to any ATM within close proximity.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. **1** is a perspective view of an embodiment of the invention as used to provide universal access to a personal desktop computer.

FIG. **2** is a schematic diagram showing the relationships of the main components shown in FIG. 1.

FIG. **3** is a diagram showing the structure of a data packet according to an embodiment of the invention.

FIG. **4** is a schematic diagram of a conventional keyboard indicating the grouping of the keys according to the invention.

FIG. **5** is a perspective view of an embodiment of the invention used to provide universal access an automatic teller machine.

FIG. **6** is a schematic diagram showing the relationships of the main components shown in FIG. 5.

FIG. **7** is a schematic diagram of an ATM keyboard indicating the grouping of keys according to the invention.

FIG. **8** is a schematic diagram of a total access system in its most general terms.

FIG. **9** is a block diagram of a total access port adapted for use with a personal computer, in accordance with the present invention.

FIG. **10** is a flow diagram showing the exchange between an accessor total access port (TAP) and a target device TAP that helps the person using the accessor TAP to locate the target device TAP.

DETAILED DESCRIPTION

FIG. **1** shows a preferred embodiment in which the target device is a conventional personal computer **10**. The computer hardware and software has not been modified or customized in any way. Also shown are a standard video monitor **11**, a conventional keyboard **12** and a mouse **14**. Rather than connecting directly to the computer, however, a keyboard cable **16** and a mouse cable **18** are connected to a target total access port (TAP) **20**. An auxiliary keyboard cable **22** and an auxiliary mouse cable **24** connect the target TAP **20** to the computer **10**. In addition, an auxiliary video cable **26** also connects the computer **10** to the target TAP **20**. Computer **10** may be operated using conventional keyboard **12** and mouse **14**, just as it is operated in the absence of TAP **20**. In addition, TAP **20** provides additional avenues for accessing and operating computer **10**.

An infrared beam **28** carries signals between the target TAP **20** and an accessor TAP **30**. An input cable **32** and an output cable **34** connect the accessor TAP **30** to a speech recognition system **36**. Connected to this system is a microphone **38**. A block diagram of this embodiment is shown in FIG. **2**.

The personal computer **10** can be any of the many such desktop and laptop computers widely used today. The speech recognition system **36** may include, for example, an ACPA card (not shown) and a 486 computer (not shown) with 12 MB RAM and a 40 MB hard disk (not shown). The microphone **38** is a high sensitivity microphone with noise cancellation properties. The target TAP **20** and the accessor TAP **30** include

conventional infrared communication technology, microprocessors, and memory, as described below in relation to FIG. 9.

When the computer is being accessed in the conventional manner, input signals from the keyboard **12** and mouse **14** pass through the keyboard cable **16** and mouse cable **18**, respectively, and into the target TAP **20**. These input signals are sent to the personal computer **10** through the auxiliary keyboard cable **22** and the auxiliary mouse cable **24** with minimal modification in the target TAP **20**. The presence of the target TAP **20** is therefore transparent to the normal interaction of the personal computer **10** with its keyboard **12** and mouse **14**. Moreover, it should be emphasized that no hardware modifications are made to the standard keyboard or mouse devices.

In addition to sending input signals from the keyboard **12** and mouse **14** to the computer **10**, the target TAP **20** can also send input signals derived from information received from the accessor TAP **30**. When verbal commands detected by the microphone **38** enter the speech recognition system **36**, they are translated into corresponding command signals which are sent to the accessor TAP **30** via input cable **32**. The accessor TAP **30** converts the command signals into the appropriate universal data packets, as described below. These packets are then transmitted to the target TAP **20** via the infrared beam **28**. The target TAP **20** then converts the universal data packets into appropriate device-specific keyboard and mouse signals, and sends these signals to the personal computer **10** via the auxiliary keyboard cable **22** and the auxiliary mouse cable **24**.

The data packets sent from the accessor TAP **30** to the target TAP **20** are universal or device-independent. For the purposes of the present application, device-independent data is

defined to be data whose format and coding is independent of the specific target and accessor device hardware representations of data. In addition, the packets represent information in a user-functional form. For the purposes of the present application, a user-functional representation of data is defined to be a representation of data in terms of actions that might be performed by a human user interacting with a human user interface device. To illustrate, consider the following examples. When the word "up" is spoken into the microphone **38**, the speech recognition system sends device-dependent ASCII characters "up" to the accessor TAP **30**, which is customized to interpret ASCII input from a speech recognition system. The accessor TAP **30** then creates a universal data packet containing a signal indicating a mouse movement upward. Such a data packet represents the user action of moving a generic pointing device upward, and is independent of any particular mouse and the hardware codes or signals it generates when moved upward. A special verbal command, such as "type", causes the accessor TAP **30** to convert characters it receives into universal data packets containing keystroke commands rather than mouse movements. For example, when the phrase "dear john colon how are you question mark" is spoken into the microphone, the device-dependent ASCII string "Dear John: How are you?" is generated by the speech recognition system and sent to the accessor TAP **30**. The accessor TAP will then convert this device-dependent ASCII string into device-independent keyboard data packets containing generic keystroke commands to type this phrase. A special verbal command, such as "move mouse", causes the accessor TAP **30** to again convert characters into data packets for mouse movements.

The keystroke commands in the data packets are user-functional in the sense that they represent the actions of the user involved in pressing a combination of keys rather than representing arbitrary device-dependent hardware codes

corresponding to various combinations of keys. For example, rather than representing the information as a sequence of device-dependent ASCII codes corresponding to the characters D, e, a, r, space, J, o, h, n, user-functional codes representing the actual keystrokes are used: shift down, d down, d up, shift up, e down, e up, a down, a up, r down, r up, space down, space up, shift down, j down, j up, shift up, o down o up, h down, h up, n down , n up. Which key is pressed or released is represented not by an arbitrary character code, but by the spatial position on the keyboard where the user has pressed or released a key. The information is thus encoded in a form that is representative of the actions the user performs to create the characters. ASCII code, in contrast, is a device-dependent code representative of characters themselves, irrespective of user actions used to press keys. The user-functional representation of data mirrors the actions of the human being rather than the computer's internal hardware codes. Representing data in terms of user actions has the advantage that it is explicit and provides for easy and intuitive adaptation of accessor-target communication without requiring the human user to have any knowledge of device-dependent codes that are hidden from the user.

As shown in FIG. **4**, the keys on computer keyboards naturally fall into distinct functional groups: the group of function keys **48**, the group of standard keys **50**, and the group of keys in a numeric keypad **52**. The user-functional representation of a keystroke includes a first byte to specify the group of keys and a second byte to specify the particular key in the group. In addition, the first byte has a bit reserved which indicates whether the key is being pressed or released. For example, if the second function key is released, a data byte pair will contain a first byte indicating a key was released and specifying the function key group, and a second byte indicating the second key in the group. It will be

appreciated that other encoding techniques may also be used to represent data in a user-functional form. For example, the first byte may reserve two bits to indicate whether a key is pressed or released. The first bit indicates a pressed key and the second bit indicates a released key. Both bits can be used to indicate that the key was pressed and released during an interval when no other key was pressed or released. This form of representation has the advantage that it is a more compact form in many cases.

FIG. **3** shows a general form for universal data packets. Each packet begins with a header **40** which identifies the type of packet, such as a mouse packet or keyboard packet. Then follows a byte count or control byte **42**, a sequence of data bytes **44**, and a two-byte cyclic redundancy check (CRC) **46**. A keyboard packet, for example, contains one header byte which uniquely identifies it as a keyboard packet, one control byte whose least significant six bits indicate how many bytes are in the rest of the packet, a sequence of data byte pairs, and two CRC bytes.

Referring now back to FIG. **1**, when a universal data packet arrives at the target TAP **20**, its device-independent data is decoded and appropriate device-dependent signals are sent to the personal computer **10**. For example, when the target TAP **20** receives a keyboard packet indicating that the second key in the function key group is depressed, it translates this information into the device-dependent ASCII code which this particular computer uses for the second function key and sends it to the computer **10**. The target TAP, therefore, is customized with a knowledge of the device-dependent codes and formats used by the target device. Since the target TAP **20** can be produced with a memory that contains the codes for all common keyboards, one TAP could be sold to operate with many computers. Moreover, if new computers are produced with

different key codes, the codes can be entered into the memory of existing TAPs and newly produced TAPs.

With this universal method of communication, an individual with a customized input device, such as the speech synthesizer **36**, can change computer systems as easily as anyone else. If the individual changes to a new type of computer, the accessor TAP **30** and the target TAP **20** briefly converse to learn about each other. Special control packets facilitate this initial dialogue and also handle other matters of protocol. This initial dialogue might include, for example, a request by the accessor TAP **30** for information from the target TAP **20** about the target system's user interface resources. The target TAP **20** then responds with a description of the spatial layout of the standard keyboard and the various types of mouse control signals expected by the target system which it is configured to serve. Note that this resource information does not contain ASCII or other codes that depend on the target device electronics. Instead, the resource information contains a user-functional description of the manner in which the target device is capable of communicating with users. Similarly, the accessor TAP also may provide to the target TAP requested resource information containing a user-functional description of the manner it which it is capable of communicating with users and/or the type of information it is capable of providing. For example, although the accessor devices may not include a keyboard, an accessor speech recognition system may be capable of providing equivalent information, in which case the accessor TAP would indicate that it is capable of providing keyboard information. From the resource information obtained in this the dialog, the accessor and target TAPs construct legends or tables containing device-independent link data and their corresponding user-functional descriptions. For example, the keyboard legend might contain the name of a key on the keyboard as well as its spatial

location on the keyboard together with a device-independent representation that is transmitted over the link. In addition, the legends contain device-dependent codes or information corresponding to these device-independent codes and user-functional descriptions. The legend in the accessor TAP allows it to translate between the device-independent keyboard data transmitted over the link and the device-dependent data used by the accessor to create alphanumeric strings. Similarly, the target TAP allows it to translate between the device-independent keyboard data received over the link and the device-dependent ASCII codes (or other key codes) understood by the computer.

FIG. **9** is a block diagram showing the internal details of a target TAP used in this embodiment. A standard TAP ROM contains instruction code and device-specific data tables that enable the TAP to operate with many common desktop and laptop computers. In addition, a customized target ROM can be included to allow the TAP to function with other less common computers and devices. A microprocessor in the TAP executes the instruction code for translating between universal data packets and the device-dependent codes specific to the target device. A standard TAP can be equipped with a communications interface for supporting both a long-range infrared (LRIR) and short-range high-speed infrared (HSIR) link, as well as an RS-232 link and an RF link. These links provide a standard TAP with a variety of communication modes for various purposes as they may arise (such as in the alternate embodiment described below). The TAP also has device interfaces which allow it to communicate with the computer and its conventional input and output devices.

The accessor TAP **30** in the embodiment of FIG. **1** is similar to the target TAP described in relation to FIG. **9**. The ROM in the accessor TAP, however, stores codes and information

specific to the accessor devices. This information enables the TAP to translate between universal data packets and the device-dependent data appropriate to the accessor devices. In addition, the accessor TAP may also include a sound and voice interface which is an intelligent layer of software that creates an intelligent bridge between voice/sound input/output and applications not originally designed to function with voice/sound input/output. The sound and voice interface instruction codes may be integrated into the TAP ROM and executed by the TAP microprocessor, or a dedicated microprocessor and ROM may be inserted in the data stream between the device and the TAP to perform the interface functions. The interface enables the user to create, edit, and initiate voice macros, and provides protection for authors of specialized voice macros by encrypting and registering the macros. It provides context-sensitive preemptive help by monitoring the system and analyzing how the user works, and provides user-initiated help to assist the user in using the accessor. The interface also warns the user against making irrecoverable errors. Since the interface is integrated into the speech recognition system **36** or accessor TAP **30** rather than the target TAP **20** or the computer **10**, it may be customized in various ways to suit the particular needs and preferences of the user without in any way imposing limitations on target devices. If a sound and voice interface is included in the embodiment to provide the user with audio help, a speaker and sound/speech synthesizer would be included as described in the following embodiment.

FIG. **5** shows an alternate embodiment of the invention. Accessor TAP **54** is connected to a speech recognition and synthesis system **56** via an input cable **58** and output cable **60**. In addition to accepting speech input from a microphone **62**, the speech recognition and synthesis system **56** also includes a speech synthesizer which sends its output to a speaker **64**. Under normal circumstances, the accessor TAP **54**

communicates via a high-speed infrared information link **66** with a target TAP **68**. Rather than being connected to a personal computer, the target TAP **68** is connected via an input cable **72** and an output cable **74** to a standard automatic teller machine (ATM) **70** having a video display **71** and a keyboard **73**. A block diagram of this configuration is shown in FIG. **6**.

The speech recognition and synthesis system **56** receives voice commands which the accessor TAP **54** converts into generic keyboard packets and transmits over the infrared information link **66** to the target TAP **68**. The target TAP **68** then converts these packets into appropriately coded device-dependent keyboard signals which are then sent to the ATM **70** via the input cable **72**. The layout of keyboard **73** is shown in FIG. **7** with the two groups of keys indicated.

FIG. **5** shows the output cable **74** carrying a video signal from the ATM **70** to the target TAP **68** which uses standard optical character recognition (OCR) technology to convert the video signal into encoded text. The target TAP **68** then creates a generic packet containing the text and transmits it to the accessor TAP **54** via the infrared link **66**. The accessor TAP **54** passes the text on to the speech recognition and synthesis system **56** which generates audible speech through the speaker **64**.

With this method for universal communication, an individual with a disability can easily access any type of ATM equipped with a TAP. Moreover, other electronic devices such as microwave ovens, fax machines, answering machines, and telephones can also be easily accessed using the same accessor TAP, provided the electronic devices are equipped with TAPs.

A person who is blind or visually impaired may have difficulty locating a desired electronic device, such as an ATM. In this case, target TAP **68** can engage in a dialog with accessor TAP **54** to assist the person in establishing a link with the ATM. A simple one-way radio frequency (RF) link **76**, such as used in common car alarm systems to enable and disable the alarm at a distance, is used to initiate the dialog. If TAP **68** receives such an RF wake-up call, it responds by sending a long-range IR (LRIR) beacon signal. Since IR links are directional, this beacon signal allows the accessor TAP **54** to determine the relative direction of the ATM TAP **68**. Once a bi-directional LRIR link is established, the accessor TAP **54** sends the ATM TAP **68** a request for a description of its resources. If the resources are satisfactory, the TAPs attempt to establish a high speed IR (HSIR) link by transmitting a test pattern. If the test fails, the TAPs may have to be moved closer together or aligned more precisely. In this manner, the TAPs can assist in establishing the TAL between electronic devices. The flow diagram shown in FIG. **10** shows this procedure in more detail.

Although the above descriptions contain many specificities, these should not be construed as limitations on the scope of the invention, but rather as an illustration of particular embodiments thereof. Many other variations are possible. For example, the information link between total access ports need not be an infrared link. It could also be a radio link, fiber optic link, electronic cable link, modem link, computer network link, or other type of communications link. For each type of link, suitable forms of data compression, error correction, and handshaking may be used.

Although the two examples illustrate the method with a personal computer and an ATM, the method is designed specifically to enable easy access to any type of electronically controlled device. Many other common devices

could be equipped with a TAP and accessed similarly. For example, it is obvious that the method may be used with a telephone, an answering machine, a fax machine, a stereo system, a VCR, a microwave oven, a TV, a video game, a copier, an environment controller, a vending machine, an elevator, a pager, a modem, an industrial controller, a telcom device, an appliance, a car, an airplane, an information kiosk, and a radio-controlled toy. In general, any device which is electronically operated or controlled can be equipped with a TAP and made universally accessible through this method.

Moreover, although the input devices and output devices illustrated are speech recognition and synthesis systems, the method is designed to allow many other customized or standard input and output devices to be used. For example, in addition to a speech recognition and synthesis system, the method may be used with a standard keyboard, a mouse, a track-ball, a joy-stick, a video monitor, a liquid-crystal display, an LED display, a speaker, a remote control, a headband switch, a printer, a personal data assistant, a sound generator, a Braille display, a tactile display, a virtual reality display, or any customized input device designed to suit the needs of a particular individual.

Although the method illustrates communication between a target device and accessor devices having human input, it is obvious that this method can also be used to link two target devices or to link accessor devices associated with two people. With standard protocol techniques, the method can also be used to link more than two devices together simultaneously. In particular, it will be appreciated that any number of accessor and target devices may be networked together using various well known digital computer networking techniques in conjunction with accessor and target TAPs. Appropriate protocols and techniques may be used to provide

enhanced performance of such networked accessor and target devices. For example, networked accessor devices can be used together to permit coordinated input, such as a headband switch used as a keyboard shift key to simplify typing for a user who is able to press only one key at a time. In another example, a networked information server can contain a centralized database of device information for many accessors and target devices, storing accessor and/or target legend information for convenient use at future times. An accessor TAP, which may have limited memory resources, then does not have the burden of storing legend information for the entire network of target devices. Instead, that information is available each time the user connects to the network via the accessor TAP.

Clearly, there are many possible variations in the particular user-functional representation used for the universal data packets. For example, keys may be grouped in different ways or given x-y coordinate representation. There also may be variations in the particular form of the universal data packets. The length of each portion of the packet may be varied, as well as the order. Moreover, there may be many distinct types of packets used to represent different types of user-functional activity or other data. For example, in addition to a keyboard packet, a universal packet may be a mouse packet, a video packet, a target data packet, a control packet, and an accessor-to-accessor packet. Other packet types can be included as required.

It will also be appreciated that embodiments of the present invention may include various tools and techniques to further assist and facilitate the user of electronic devices. In particular, many customizations of the accessor devices and accessor TAP may improve the efficiency and ease with which a user interacts with the accessor devices. For example, accessors and/or TAPs can provide the capability to define

and execute macros in order to simplify the performance of routine sequences of actions. All such customizations are localized in the accessor and/or accessor TAP and are transparent to the target device. The invention, therefore, takes advantage of these types of personal access customizations while not limiting the target device, or requiring its modification or customization in any way. Moreover, the accessor customizations are portable, allowing the user to take advantage of them when using other target devices.

In view of the above variations and other variations that will be appreciated by those skilled in the art, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their legal equivalents.

CLAIMS

1. A method for communication between electronic devices in a communication system comprising an accessor device connected to an accessor total access port, a target device connected to a target total access port, and a total access link between the accessor total access port and the target total access port, the method comprising:

converting user actions into electronic data using the accessor device, wherein the accessor device is a human user interface device;

sending the electronic data from the accessor device to the accessor total access port;

translating the electronic data sent from the accessor device from a device-dependent form into a device-independent form containing a user-functional representation of the electronic data sent from the accessor device;

transmitting the translated device-independent data over the total access link from the accessor total access port to the target total access port;

translating the transmitted data into a device-dependent form specific to the target device; and

sending the translated device-dependent data from the target total access port to the target device.

2. The method of claim 1 wherein the total access link comprises an information link chosen from the group consisting of

an infrared link, an electronic cable link, a computer network link, a fiber optic link, and a radio frequency link.

3. The method of claim 1 wherein the total access link comprises a bi-directional serial transmission link with error-handling, error-correction, handshaking, data packing, and data unpacking.

4. The method of claim 1 wherein the transmitting comprises creating a generic data packet chosen from the group consisting of a keyboard packet, a mouse packet, a video packet, a target data packet, a control packet, and an accessor-to-accessor packet.

5. The method of claim 1 wherein the accessor device is selected from the group consisting of a keyboard, a mouse, a track-ball, a joy-stick, a video monitor, a liquid-crystal display, an LED display, a speaker, a voice synthesizer, a speech recognition system, a remote control, a headband switch, a printer, a sound generator, Braille display, a tactile display, and a virtual reality display.

6. The method fo claim 1 wherein the accessor device comprises a speech recognition and synthesis system and the accessor total access port comprises a sound and voice interface for facilitating the use of speech input.

7. The method of claim 1 wherein the target device comprises a personal computer, and the target total access port comprises a ROM containing communication resource information about the personal computer.

8. The method of claim 1 further comprising sending a radio frequency wake-up call from the accessor total access port to the target total access port.

9. An accessor total access port in a system comprising an accessor device connected to the accessor total access port, a target device connected to a target total access port, and a total access link between the accessor total access port and the target total access port, the accessor total access port comprising:

a microprocessor,

an accessor device interface between the microprocessor and the accessor device for communicating device-dependent electronic data between the accessor device and the microprocessor;

a memory means containing data about the accessor device and instruction code comprising instructions for the microprocessor to translate the device-dependent electronic data from the accessor device into device-dependent data containing a user-functional representation of the electronic data from the accessor device, wherein the data about the accessor device includes device-dependent accessor data, device-independent link

data, and user-functional descriptions; and

a communications interface between the microprocessor and the total access link for transmitting the device-independent data over the total access link to the target total access port.

10. The total access port of claim 9 wherein the communications interface comprises an infrared transceiver.

11. The total access port of claim 10 wherein the infrared transceiver transmits the universal data packet with error-handling, error-correction, handshaking, data packing, and data unpacking.

12. The total access port of claim 9 wherein the microprocessor formats the device-independent data into a data packet chosen from the group consisting of a keyboard packet, a mouse packet, a video packet, a target data packet, a control packet, and an accessor-to-accessor packet.

13. The total access port of claim 9 wherein the accessor device comprises a speech recognition and synthesis system and the total access port comprises a sound and voice interface for facilitating the use of speech input.

14. A system for interfacing a human user with an electronic device, the system comprising:

an accessor device interfaced directly with the user;

a first microprocessor connected to the accessor device and programmed to translate between a device-dependent data format associated with the accessor device and a device-independent data format, where the device-independent data format directly represents interactions of the user and the accessor device;

a second microprocessor connected to the electronic device and programmed to translate between device-independent data and a data format specific to the electronic device; and

a communication link connecting the first and second microprocessors, wherein the universal data packets are transmitted over the communication link from the first microprocessor to the second microprocessor.

15. A method for interfacing a human user with an electronic device, the method comprising:

receiving input signals from an input/output device customized to the human user, wherein the input signals comprise device-dependent codes;

translating with a first microprocessor the input signals into device-independent data representing user actions;

transmitting the device-independent data over a communications link from the first microprocessor to a second microprocessor;

translating with the second microprocessor the device-independent data into device-dependent data specific to the electronic device; and

sending the device-dependent data to the electronic device.

16. The method of claim 15 further comprising transmitting a description of input/output device resources over the communications link.

ABSTRACT OF THE DISCLOSURE

A method of interfacing human users with electronic devices liberates electronic devices from specific input and output devices and substitutes a universal communication system between them. The method combines the advantages of personal customization with the advantages of unlimited access to electronic devices. In particular, it provides disabled individuals with full access to suitably equipped electronic devices such as ATMs, telephones, fax machines, computers, copiers, TVs, VCRs, stereos, and microwave ovens. This method therefore provides the means for making these important electronic devices equally accessible to everyone. In a preferred embodiment, the communication system includes a speech synthesis and recognition system [**56**] which is connected to an accessor total access port [**54**], an ATM [**70**] connected to a target total access port [**68**], and a total access link [**66**] between the accessor total access port [**54**] and the target total access port [**68**]. The total access link [**66**] is an information link over which universal data packets are transmitted between the total access ports. The universal data packets have a device-independent form and contain user-functional representations of data. A dialog initiated by the accessor total access port [**54**] helps the user locate the ATM [**70**] and establish a total access link.

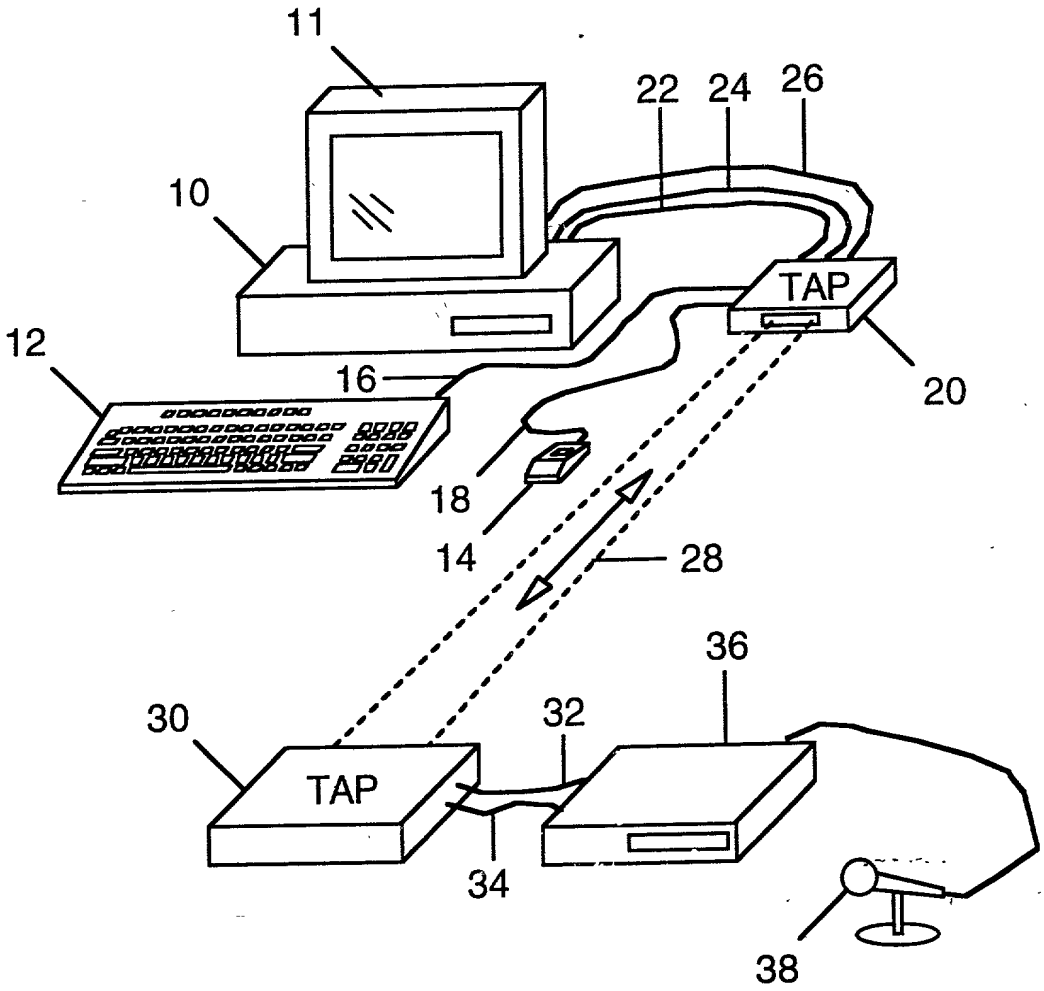

FIG. 1

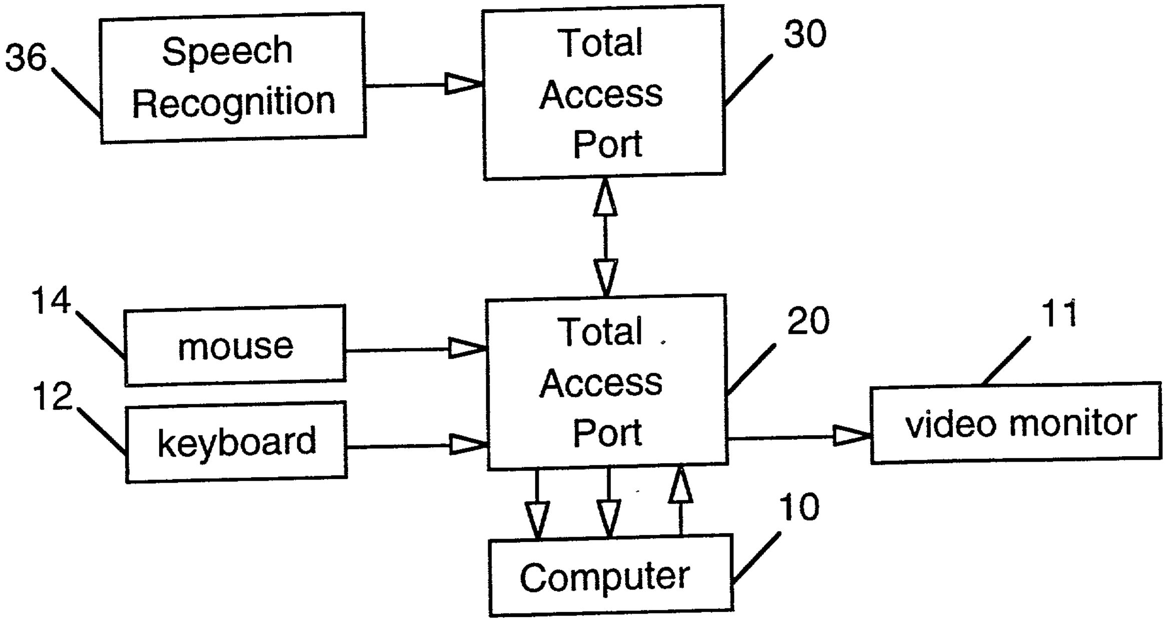

FIG. 2

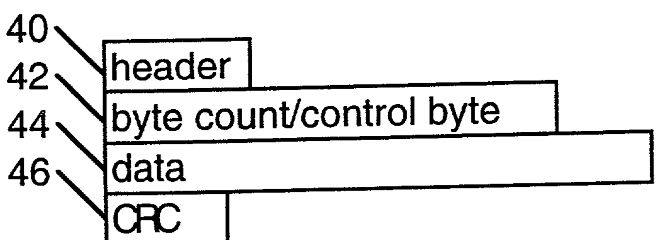

FIG. 3

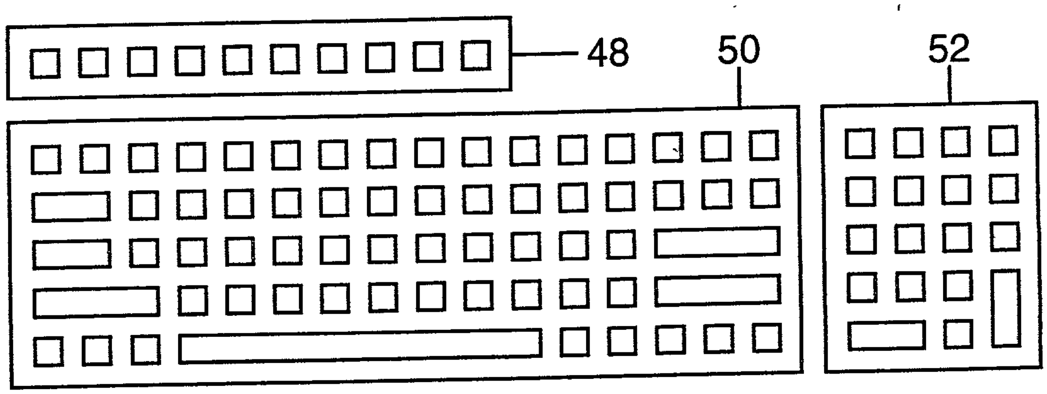

FIG. 4

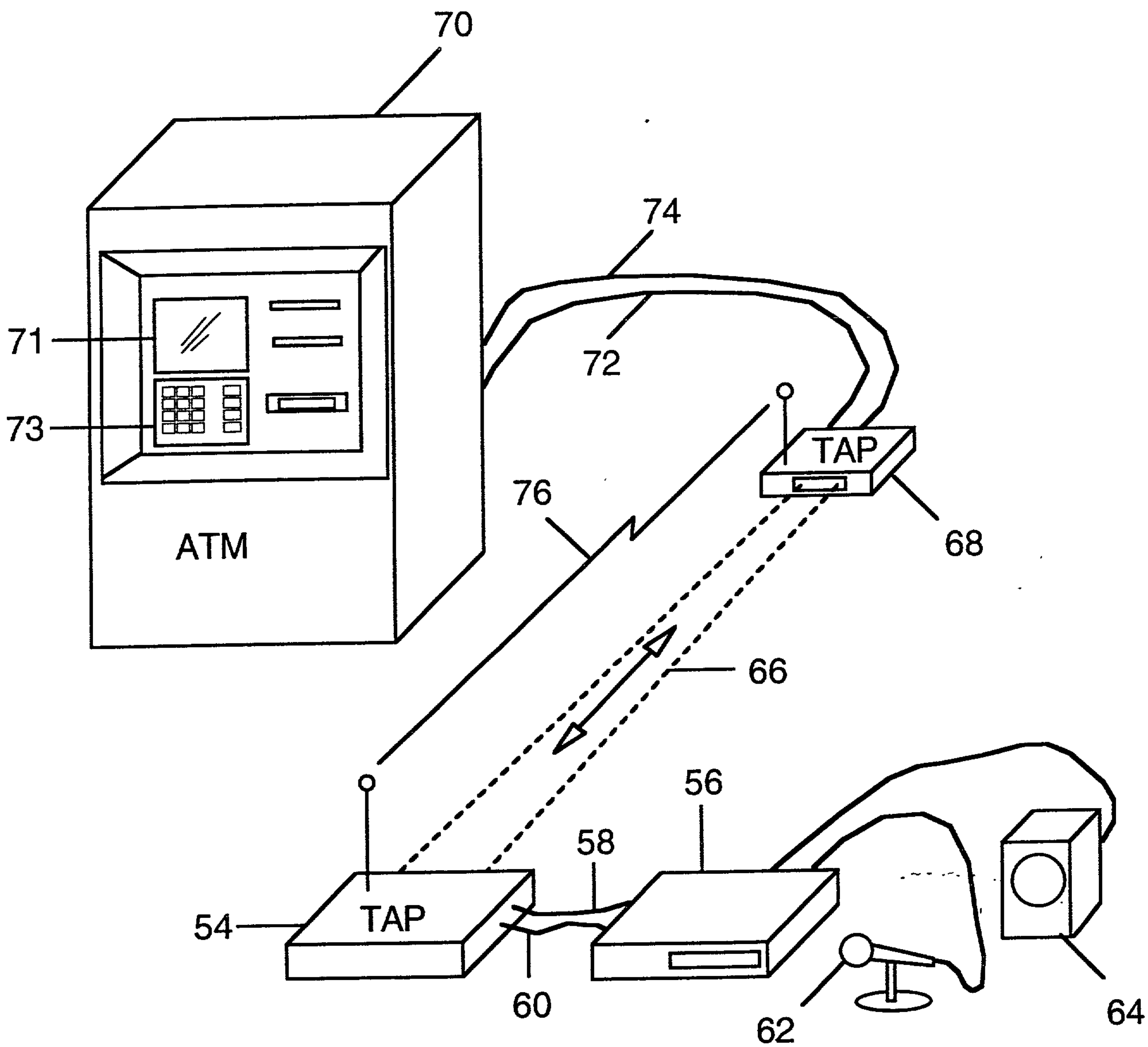

FIG 5

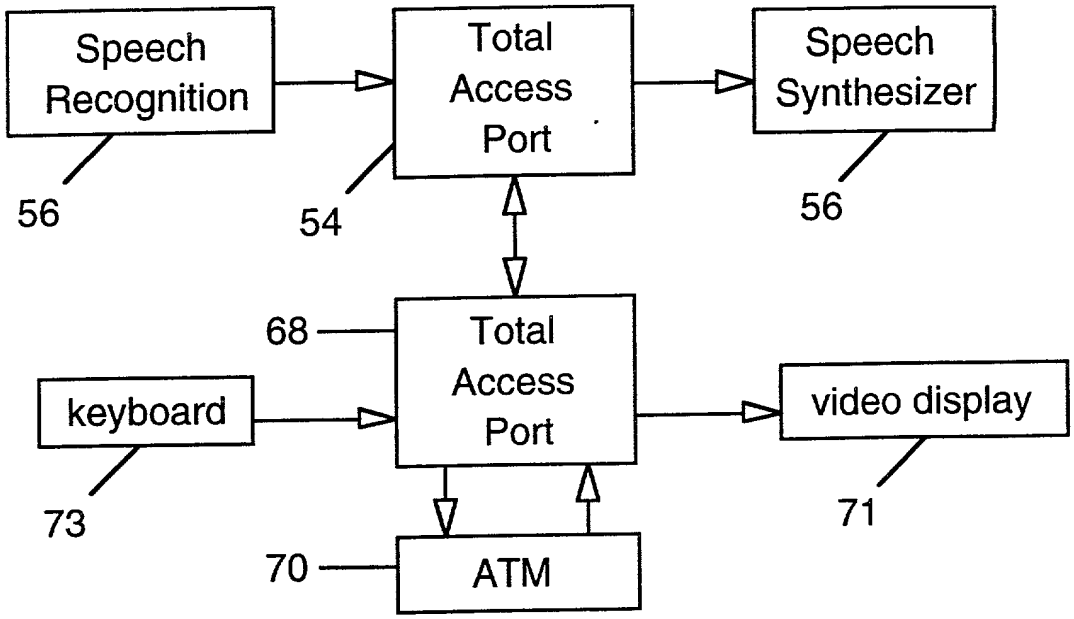
Speech Recognition
Total Access Port
Speech Synthesizer
56
54
56
68
Total Access Port
keyboard
video display
73
71
70
ATM

FIG. 6

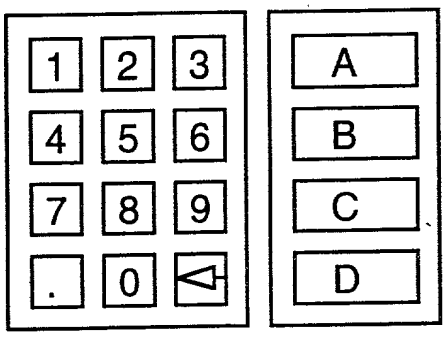
1
2
3
4
5
6
7
8
9
.
0
A
B
C
D

FIG. 7

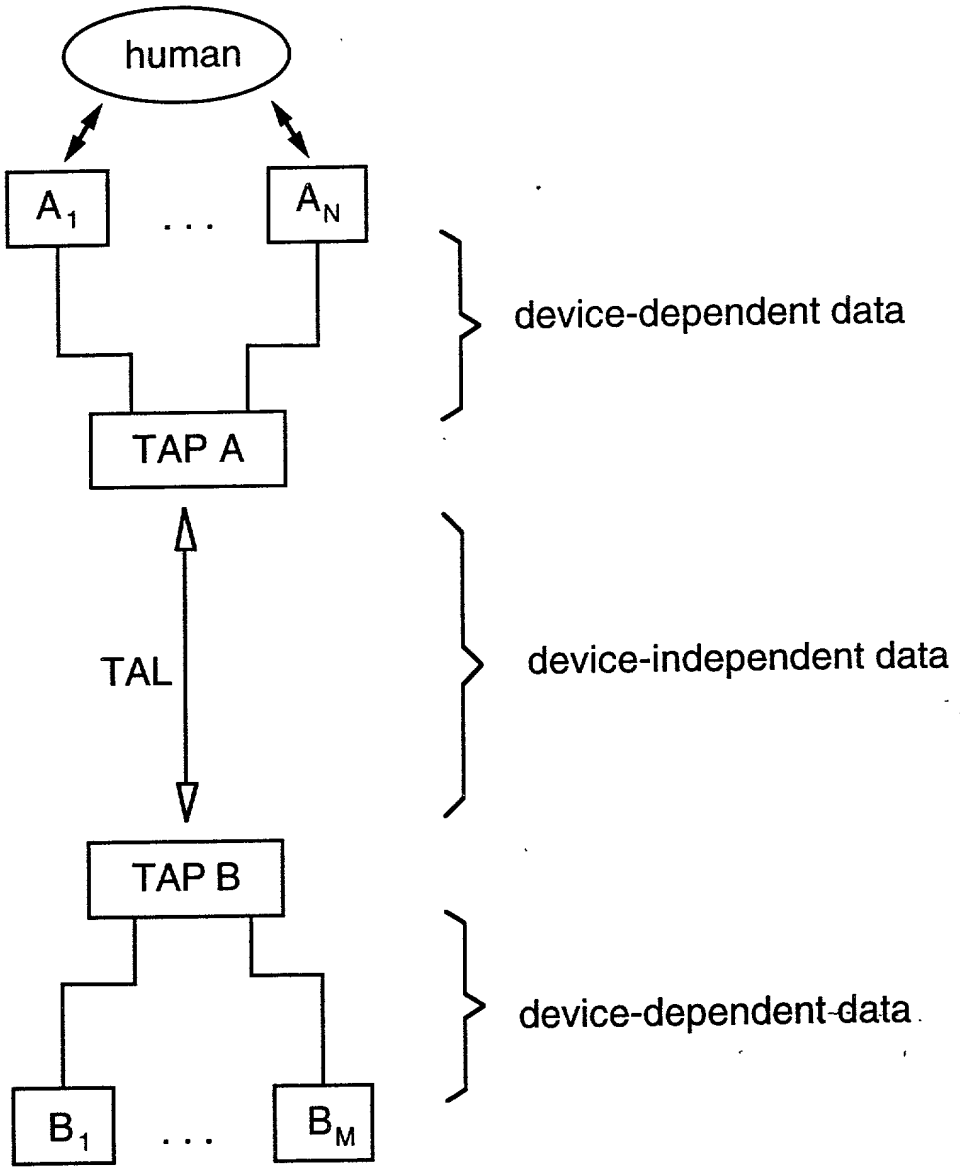
human
A1
...
AN
device-dependent data
TAP A
TAL
device-independent data
TAP B
device-dependent-data
B1
...
BM

FIG. 8

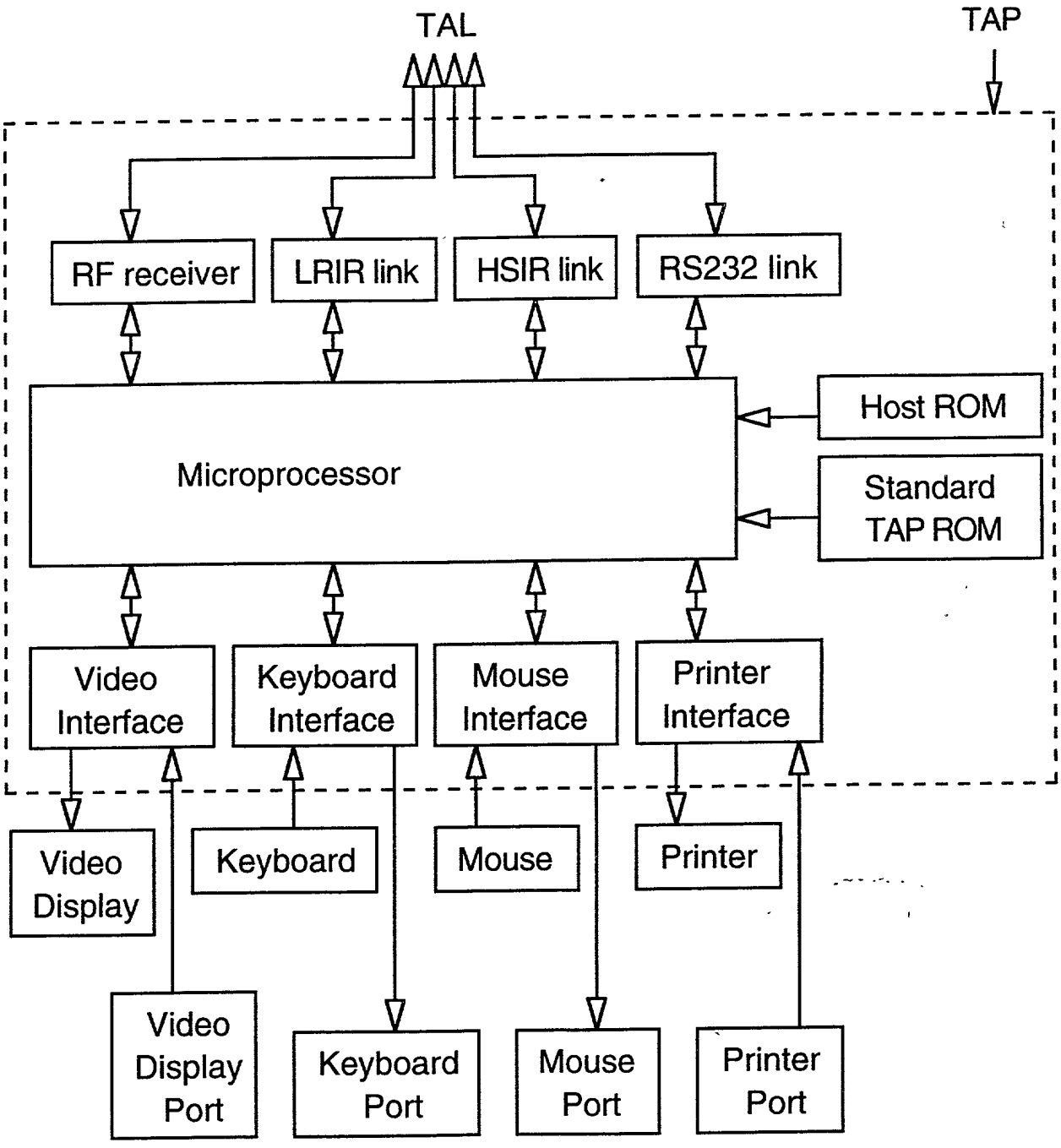
TAL
TAP
RF receiver
LRIR link
HSIR link
RS232 link
Microprocessor
Host ROM
Standard TAP ROM
Video Interface
Keyboard Interface
Mouse Interface
Printer Interface
Video Display
Keyboard
Mouse
Printer
Video Display Port
Keyboard Port
Mouse Port
Printer Port

FIG. 9

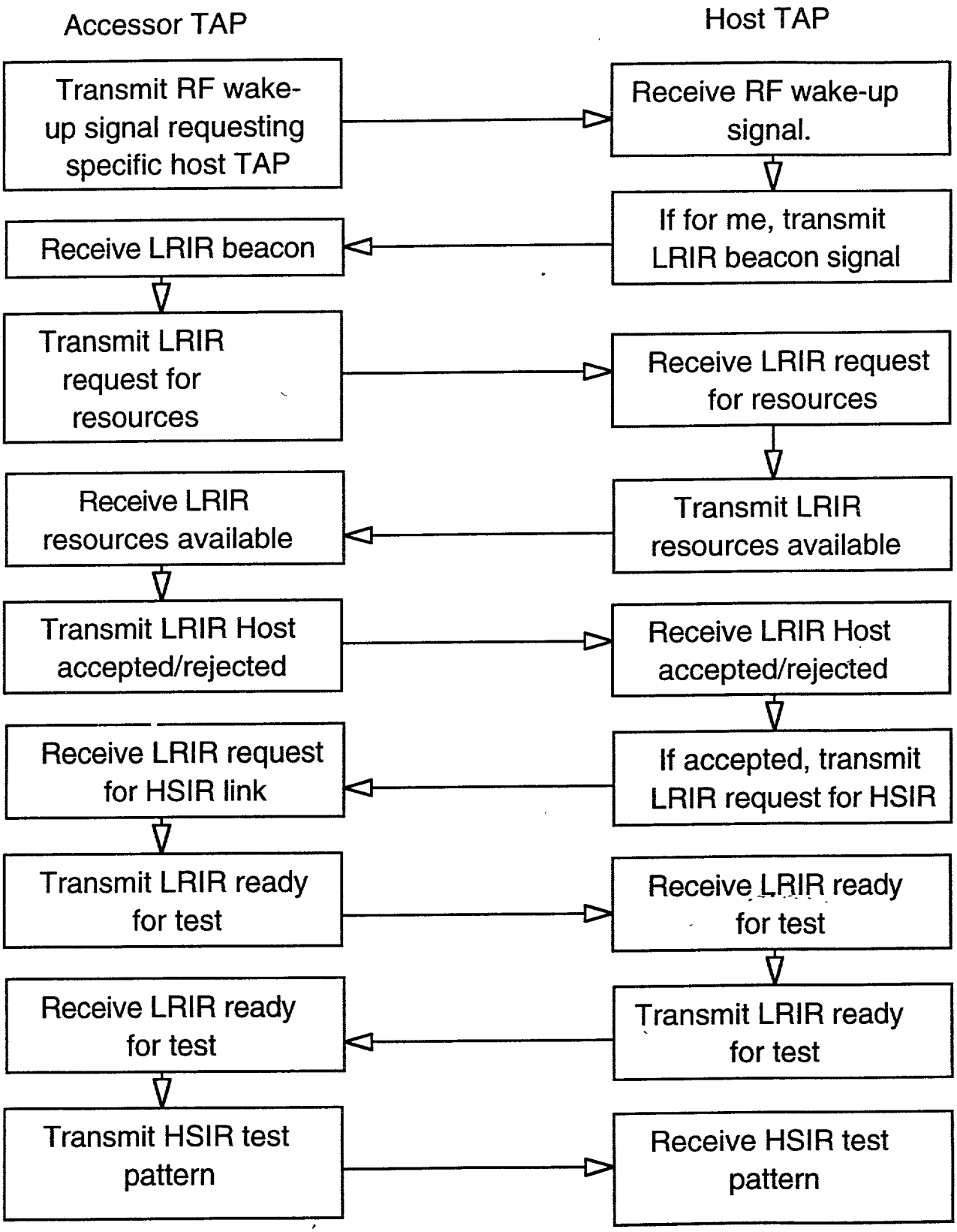
Accessor TAP
Host TAP
Transmit RF wake-up signal requesting specific host TAP
Receive RF wake-up signal.
If for me, transmit LRIR beacon signal
Receive LRIR beacon
Transmit LRIR request for resources
Receive LRIR request for resources
Transmit LRIR resources available
Receive LRIR resources available
Transmit LRIR Host accepted/rejected
Receive LRIR Host accepted/rejected
If accepted, transmit LRIR request for HSIR
Receive LRIR request for HSIR link
Transmit LRIR ready for test
Receive LRIR ready for test
Transmit LRIR ready for test
Receive LRIR ready for test
Transmit HSIR test pattern
Receive HSIR test pattern

FIG. 10

Attorney Docket: **S93-192a/CIP**

Declaration for Patent Application and Power of Attorney

As a below named inventor, I hereby declare that my residence, post office address, and citizenship are as stated below next to my name, and that I believe I am the original, first and sole inventor (if only one is listed) or an original, first and joint inventor (if plural names are listed) of the subject matter which is claimed and for which a patent is sought on the invention described in application no.: 09/107,807 filed 30 June 1998 entitled **Devices and Methods for Interfacing Human Users with Electronic Devices.**

First or Sole Inventor:	Full name:	**NEIL G. SCOTT**	Citizenship:	**New Zealand**
	Residence:	**603 Myrtle Street, Half Moon Bay, CA 94019**		
	Postal Address:	**same as above**		

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

Country	Application Number	Date of Filing	Priority Claimed Under 35 U.S.C. §119
NONE			[ ] Yes [ ] No

I claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing data of this application.

PRIOR U. S. APPLICATION(S)

Application No.	Filing Date	Status			
08/409,409	**3/24/95**	[ ] Provisional	[ ] Patented	[X] Pending	[ ] Regular

I hereby appoint Thomas J. McFarlane, Reg. No. 39,299 , Marek Alboszta, Reg. No. 39,894 as my agents with full power of substitution to prosecute this application and transact all business in the United States Patent and Trademark Office connected therewith. Direct all correspondence to:

Thomas J. McFarlane
426 Lowell Avenue
Palo Alto, CA 94301-3813
Telephone: 650-321-6630
Fax: 650-321-1621.

The attorney docket number for this case is: **S93-192a/CIP**.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Title 18, §1001 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

INVENTOR SIGNATURE(S)

N Scott — 9/10/98

NEIL G. SCOTT — Date

530.37031PX1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: N. SCOTT

Serial No.: 09/107,807

Filed: June 30, 1998

For: DEVICES AND METHODS FOR INTERFACING HUMAN USERS WITH ELECTRONIC DEVICES

Group:

Examiner:

POWER OF ATTORNEY BY ASSIGNEE OF ENTIRE INTEREST
(REVOCATION OF PRIOR POWERS)

Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

As assignee of record of the entire interest of the above-identified application for U.S. Letters Patent, recorded on September 21, 1998, Reel 9476, Frame 0034, all powers of attorney previously given are hereby revoked and the following attorneys are hereby appointed to prosecute and transact all business in the U.S. Patent and Trademark Office connected therewith.

Donald R. Antonelli, Reg. No. 20,296;
David T. Terry, Reg. No. 20,178;
Melvin Kraus, Reg. No. 22,466;
Stanley A. Wal, Reg. No. 26,432;
William I. Solomon, Reg. No. 28,565;
Gregory E. Montone, Reg. No. 28,141;
Ronald J. Shore, Reg. No. 28,577;
Donald E. Stout, Reg. No. 26,422;
Alan E. Schiavelli, Reg. No. 32,087;
James N. Dresser, Reg. No. 22,973;
Carl I. Brundidge, Reg. No. 29,621;
Paul J. Skwierawski, Reg. No. 32,173; and
Dale Curtis Hogue, Sr., Reg. No. 32,823.

Send all correspondence to:

ANTONELLI, TERRY, STOUT & KRAUS, LLP
1300 North Seventeenth Street
Suite 1800
Arlington, VA. 22209

Direct all telephone calls to:

Dale Curtis Hogue, Sr.
(703) 312-6600

Executed this 22 day of March, 1999.

By: ______________________
Jon Sandelin
Acting Director
Stanford University
Office of Technology Licensing